GEO-HYDRO, INC
Consulting in Geology and Hydrogeology

1928 E. 14th Avenue
Denver, Colorado 80206
(303) 322-2171

Comments on the Draft Remedial Investigation Report Prepared by Geo-Hydro Inc. on behalf of People in Need of Environmental Safety

Geo-Hydro Inc., on behalf of People In Need of Environmental Safety (PINES), is submitting the following comments on the Draft Remedial Investigation Report on the Pines Area of Investigation dated May 19, 2008.

General Observations

The draft Remedial Investigation report is a nicely prepared and very carefully crafted advocacy document. As a scientific report however, it lacks even the most basic elements of a complete and unbiased Remedial Investigation. Some of the most important elements missing, misunderstood or misstated include:

- Depictions of the water table and groundwater flow lines do not reflect realistic groundwater flow conditions nor reflect building head within the landfill cells. The contour maps incorrectly omit up to 7-feet of head in the vicinity of Yard 520.
- The South Unit of Yard 520 has been unrealistically removed from the evaluated groundwater flow system and modeling domain. This is a likely cause of some of the many problems with mapping and modeling hydraulic heads in the vicinity of Yard 520.
- The lateral extent and internal concentration gradients of contaminants within the groundwater plumes have not been identified. The relative changes in plume extent and center of contaminant mass between sampling events have not been evaluated.
- The groundwater flow model is misleading and is inadequate to meet project objectives. It was necessary to censor PZ001 (the highest measured head in the area) from the data in order to calibrate to the remaining downgradient data points. None of the reported simulations honor the observed leachate head in the Yard 520 landfill and none reflect real-world conditions.
- Piezometer PZ001 data show that the heads within Yard 520 are increasing. For contamination from the CCB in Yard 520, none of the data to date, therefore, represent the conditions of highest migration rates away from this landfill complex. Rather than attempting to establish how much worse the situation around Yard 520 will become when it finally achieves a dynamic equilibrium (steady-state), the RI inappropriately ignores and dismisses the PZ001 data, thereby representing the conditions observed during the period of the investigation as a worst-case scenario.
- Background soil and groundwater data sets were developed based on unreliable visual examination of soil sample and well installation locations. There was no subsequent analysis to identify and eliminate impacted samples from those data sets. Both soil and groundwater background samples need to be evaluated to eliminate impacted samples. Mixing of granular and organic soil types into one background soil data set creates inappropriate statistical characterization of background and masks impacted samples to further diminish the utility of the data.

- Discussions of surface water and sediment chemical analyses repeatedly describe upgradient detections of CCB-derived metals as unrelated to CCBs due to their locations upstream of known CCB disposal sites. These claims ignore the certainty that there are other CCBs in locations upstream of the RI-acknowledged sites. The simplest, most straightforward understanding of these "anomalous" upgradient data is that those samples are impacted by the as-yet unacknowledged CCB disposal sites. See specific comment #2 for details of how this is known.

<u>Specific Comments</u>

1) Page 1-8, Section 1.3.5 - The last paragraph of this section indicates that the radionuclide data presented in the document titled "Evaluation of the Data Collected Under the Yard 520 Sampling and Analysis Plan" will be evaluated in the Human Health Risk Assessment and the Ecological Risk Assessment. A Health Physicist member of PINES, Mr. Larry Jensen, reviewed and prepared comments on that report. Mr. Jensen's comments on the Yard 520 report are included here as Attachment 1.

2) Page 2-10, Section 2.4 – Samples of surface soil from the Islamic Center and the Kysel residence, outside of the Area of Concern and upgradient and upstream of Yard 520, were collected by PINES members and sent to Dr. Maria Mastalerz at Indiana University for microscopic examination. Dr. Mastalerz's examination indicated (Attachment 2) that the samples contain varying percentages (1 to 20%) of CCBs. This finding demonstrates: 1) that the locations of suspected CCBs identified in the draft RI by no means represent the entire distribution of CCBs in and around the area of investigation, 2) that mixtures of CCB and soil, not merely end member compositions, are present in the area, and 3) that "background" soil and groundwater samples are potentially impacted by CCB deposits that have not been identified through visual inspections of the surface materials. These findings cast doubt on identifications of all background soil and water sampling locations that are based on the lack of visually identifiable CCBs.

3) Page 2-12, Section 2.6 - The first paragraph of this section states that, "background surface soil samples were collected from locations known to not contain suspected CCB's to determine site-specific background conditions." The ability to distinguish between soil and CCB is predicated on the validity of a simple visual examination. The draft RI report does not describe the criteria of that visual examination or any independent test(s) that verified the validity and adequacy of the visual protocol. Further, the ability of field personnel to distinguish soil impacted from CCBs through visual methods is even more dubious now that it has been established (see previous comment) that CCB and soils exist as mixtures in varying percentages. By what reliable, objective criteria is it 'known" that the selected background locations do not "contain suspected CCB's" or, equally important, not include CCB impacts?

4) Page 2-15, Section 2.7.1 – Identification of the highest concentrations of B and Mo consistently in the middle of the shallow aquifer rather than near its base indicates that discharge from the deep aquifer is not the source of elevated metals concentrations found in the shallow aquifer as was asserted in the project planning documents.

5) Page 2-32, Section 2.17 - The information submitted by the respondents purportedly to investigate subsurface soils for accumulation of arsenic is non-responsive to the question. Samples of clay at the bottom of the shallow aquifer along the edge of Yard 520 are not located properly to identify arsenic that has been sequestered from the contaminant plume(s). The discussion of arsenic migration presented by the Respondents on page 5-7 rightly indicates that, "Based of the groundwater data in the vicinity of Yard 520, attenuation processes appear to be very effective in removing As from groundwater". We agree that the processes of sorption and/or co-precipitation identified by the respondents are important mechanisms in removing arsenic from groundwater. However, the unanswered question remains. Where is the arsenic that is being removed from the groundwater, how concentrated is it now, and how concentrated will it eventually become? The groundwater data shows that groundwater migrating laterally away from Yard 520 encounters REDOX conditions and/or sorptive materials that remove arsenic from solution. The arsenic is not destroyed, it does not evaporate, <u>it is accumulating in the soil</u>. Arsenic is increasing in soil at some location or over some distance between Yard 520 and downgradient wells as it is removed from the water. This same process is likely to be occurring downgradient of other sizeable flyash deposits outside of Yard 520. Sampling of clay at the base of the shallow aquifer along the edge of Yard 520 does not address the question of where and by how much is arsenic accumulating in soils between the disposal cell and downgradient wells. Subsurface soil samples need to be collected within the path(s) of migration at intervals between Yard 520 and downgradient wells to attempt to locate the arsenic that is being removed from groundwater and accumulating in the subsurface soils.

6) Page 3-5, Section 3.4.2, last paragraph – Figure 3-2 does not show any mounding of groundwater beneath the South Unit of Yard 520. Since PZ001 is the only data point within either of the landfill cells, leachate elevation in the North and South Areas should reflect at least the development of a mound consistent with PZ001. Please show leachate levels in the disposal cells consistent with measured elevation of leachate at PZ001.

7) Page 3-6, Section 3.4.2, last bullet – The assumption that the South Area of Yard 520 has no interaction with the surrounding aquifer is hydrologically unrealistic and is based on no empirical data. Installation and continuous monitoring of piezometers inside and outside of Yard 520 would be necessary to demonstrate lack of a hydraulic connection. Recall that the respondents forcefully argued in the Site Management Strategy document that groundwater flowed upward through the clay confining unit in sufficient volume to contaminate the surficial aquifer. It is a contradiction to argue in a planning document that water readily flows through a thick confining layer and then argue in the RI that a 10-foot barrier completely isolates the landfill cell from the groundwater flow system. We agree that the clay walls will slow migration to the extent and location(s) where constructed, but completely removing the south cell from the shallow system is neither accurate nor appropriate. The water table contour maps, flow direction lines, lateral flow directions and velocities and the entire groundwater modeling effort is unnecessarily compromised by this assumption.

8) Page 3-8, Section 3.4.3, first full paragraph – The discussion of groundwater levels acknowledges but fails to address the concern that bringing in municipal water supply to Pines has had the unanticipated effect of increasing groundwater levels to the point that wet and flooded basements result. The discussion in this paragraph states that there is no indication that water levels are <u>currently</u> rising. Whether or not water levels continue to rise is not the issue. The people of Pines have asked for an unbiased evaluation of whether provision of public water without public sewer service may have caused an increase in the water table in the immediate vicinity of their homes as

the result of the introduction a new water source concomitant with the removal of a groundwater sink. Neither the information provided in this section nor the groundwater model report (Appendix L) appropriately addresses this question. A calibrated and functioning groundwater model could be used to investigate this issue by applying additional recharge equivalent to municipal water use to individual cells near homes to determine the amount of water table rise that would be anticipated. Uniformly applying additional infiltration to the entire model domain does not accurately reflect the physical system.

9) Page 3-8, Section 3.4.3, second full paragraph – The discussion of water levels in PZ001 completely ignores the more reasonable and straight-forward explanation; water level increases observed during the RI sampling reflect a building groundwater mound within the fill area. Formation of groundwater mounds beneath landfill areas is expected and is not a phenomenon that can be explained away by invoking measurement errors. The concept that silting of the well might be responsible for rising heads is simply untenable. As the only program monitoring point for the measurement of head within either landfill area, PZ001 must be presumed to reflect the representative groundwater elevation of the zone of saturation of both the North and South landfill cells. If it were believed otherwise, additional monitoring locations would be needed.

10) Page 3-8, Section 3.4.3, third full paragraph – This section introduces groundwater contour maps (Figures 3-5 through 3-9) prepared from each of the five water level gauging events. These maps are both inaccurate and therefore deceiving. Problems associated with these depictions include:

a) The contours on the groundwater contour maps are inaccurate and at too large an interval to show details of variation in groundwater flow. Given the low gradients in areas away from Yard 520,contour intervals should be drawn at no more than 1-foot intervals. The scale of the maps should be increased to facilitate viewing of the additional detail in the new drawings.

b) The groundwater contour maps inaccurately depict the head in Yard 520 North Area to be highest in a circular area immediately surrounding PZ001. This is an artifact of the lack of data in the disposal cells. Please rework the maps to project the appropriate water level across the entire landfill area rather than an isolated high in the immediate area of the piezometer.

c) Table 2-2 in Appendix L indicates that the water elevation in PZ001 during August 2006 was 619.56 feet. The groundwater contour map shown in Figure 3-5 shows the elevation of water in PZ001 as just over 616 feet for the same period. The contour map is off by 3.5 feet at PZ001. Please prepare accurate groundwater contour maps that accurately reflect the water elevations at PZ001 and appropriately project leachate head levels across the landfill cells.

d) Table 2-2 in Appendix L indicates that the water elevation in PZ001 during October 2006 was 620.43 feet. The groundwater contour map shown in Figure 3-6 shows the elevation of water in PZ001 as less than 620 feet for the same period. Please prepare accurate groundwater contour maps that accurately reflect the water elevations at PZ001 and appropriately project leachate head levels across the landfill cells.

e) Table 2-2 in Appendix L indicates that the water elevation in PZ001 during January 2006 was 621.26 feet. The groundwater contour map shown in Figure 3-7 shows the elevation of water in PZ001 as touching the 620-foot contour for the same period. Larger scale water table maps with contours drawn at 1-foot intervals will help alleviate this problem. Please prepare accurate groundwater contour maps that accurately reflect the water elevations at PZ001 and appropriately project leachate head levels across the landfill cells.

f) Table 2-2 in Appendix L indicates that the water elevation in PZ001 during April 2007 was 622.18 feet. PZ001 is obscured on drawing 3-8, but appears to be shown at approximately 620 feet for the same period. The water table map appears to be off by approximately 2 feet at PZ001! Please prepare accurate groundwater contour maps that accurately reflect the water elevations at PZ001 and appropriately project leachate head levels across the landfill cells.

g) Table 2-2 in Appendix L indicates that the water elevation in PZ001 during July 2007 was 622.95 feet. The groundwater contour map shown in Figure 3-9 shows the elevation of water in PZ001 as just over 616 feet for the same period. The water table contour map is off by almost 7 feet at PZ001! Please prepare accurate groundwater contour maps that accurately reflect the water elevations at PZ001 and appropriately project leachate head levels across the landfill cells.

h) Eliminating the Yard 520 South area from the groundwater flow system is neither appropriate nor accurate. Any low permeability barriers that were installed around the Yard 520 South Area would only slow, not eliminate groundwater flow. The lateral hydraulic gradient across the clay barriers will be steep, but flow is not totally eliminated. Also, since the caps on each of the landfill areas are equivalent, we should expect that a groundwater mound is also developing in the south area. In fact, the South Area mound may be developing more rapidly and higher than the mound observed in the North Area because flow out of the unit should be slowed by the presence of any low permeability barriers. [E.g., the rising heads in PZ001 may reflect the recent buildup of yet higher heads in the South Area.] The effect of this change will be to alter groundwater contour and flow direction lines present on each of the maps. This defect may have played a part in the Respondents' inability to calibrate the groundwater flow model without censoring PZ001 head data (See Comments on Page 3-23 and Appendix L). Please rework these maps to more accurately reflect conditions that are observed and/or reasonably anticipated in all parts of Yard 520.

11) Page 3-10,Section 3.4.4, last paragraph – Hydraulic gradient and associated flow velocities are highly variable across the site, especially in the vicinity of Yard 520. Please identify the specific locations and directions where gradients are measured and provide a range of groundwater gradients, directions, and flow velocities rather than making a vague statement like "assuming a typical gradient".

12) Page 3-23, Section 3.8 – The groundwater flow model is unusable for RI purposes. The discussion of the groundwater flow model lays out the original objectives including:

- Quantify the rate and direction of groundwater movement, and
- Quantify the rates and direction of groundwater discharge to surface water.

The discussion then goes on to state that the model was calibrated to water level measurements obtained during the RI. This is a false statement. The model could not be calibrated to reflect water level measurements without removing PZ001. This inability to calibrate with landfill head was mentioned neither in the draft RI Report text nor in the text of Appendix L. It was acknowledged only as a note at the bottom of Table 2-2 in the Appendix. A model that will not calibrate without censoring critical data points is a non-functional, unreliable model. Removing the data point that reflects the highest head anywhere in the domain, the head representing the single largest source of contamination, in order to attain pseudo-calibration completely invalidates the model and casts doubt on all discussions and/or conclusions in the RI report. The groundwater model must be re-done with realistic assumptions to accurately reflect the observation of building heads within Yard 520 disposal cells, the rate and direction of groundwater flow, and it's eventual points and rates of discharge.

13) Page 4-2, Section 4.2 – The draft RI Report interestingly includes no evaluation of the soil samples that were used to define the background soil data set. This is not surprising since the respondents have always asserted that metals concentrations in soil are only of significance if they are above both background and risk-based screening levels. Soil samples included in the background data set were selected on the basis of an uncalibrated visual distinction between of soils and CCBs. The background population includes samples collected during the water line installation project. Since CCBs are present in varying percentages along roads throughout the area, the problem is not simply to distinguish between pure CCB and pure soil; it is to determine which samples contain some amount of CCB. Further, it is impossible to visually determine which samples are unimpacted soils even among samples solely of soil, because samples without CCB may still be impacted by proximal CCB. Analysis of the data from hypothesized background sampled is needed to screen the data for CCB impacts. Graphical analysis of the background soil data set (Attachment 3) for select CCB-related parameters shows that 11 of the soil samples that were included in calculations of background concentrations are impacted soils, likely from a CCB component or CCB in the area, and not appropriate for definition of background. These samples must be removed from the background soil data set to facilitate representative comparisons.

Impacted Samples Included in Background Data Set										
SS015	SS016	SS018	SS021	SS022	SS024	SS025	TP007	TP030	TP043	TP044

14) Page 4-3, Section 4.2.1 – The evaluation of background soil inappropriately mixes different soil types (granular soil and organic soil). Organic soils located in low-lying wetland areas are distinctly different and will have a distinctly different chemical composition than granular dune sands. Comparison of granular soils consisting primarily of dune sands from neighborhoods and back yards against a background data set that includes organic wetland soils is inappropriate and misleading. Inappropriately including multiple soil types into a single background population results in data set statistics that are overly broad and are not descriptive of any soil type. Background needs to be established for each of soil types in order to allow accurate comparisons against background for that soil type. Please establish separate background ranges for organic and granular soil types.

15) Page 4-5, Section 4.2.3 – Assuming that site-specific background data sets are developed for each soil type and are strictly composed of local soils with no CCB component or impact, departures from background for impacted soils and neighborhood CCB placements can be quantified and risk assessments can be performed. But, not until then. The two and one-half pages of references discussing the background concentration of arsenic in soils across the United States are irrelevant to site-specific risks associated with exposure to the citizens of Pines. The national range of arsenic concentrations could be made somewhat more relevant by adding a discussion of similar detail describing the elevated concentrations of arsenic found in CCBs at various sites across the country, providing data on historic deposition rates of CCB on downwind areas, and isolating

those values from the nationwide background. But, as interesting as such an assessment might be, it still would have basically nothing to do with the proper implementation of an RI to allow meaningful risk assessments.

16) Page 4-16, Section 4.4.2 – Construction of individual iso-concentration maps for each parameter detected above the screening level, for each sampling event, is a standard method of depicting groundwater analytical data that is missing from this draft RI. Iso-concentration maps aid in evaluating changes in the location of the center of the contaminant as well as identifying the edges of the contaminant plume at the time of each sampling event. This type of information is critical if groundwater flow and contaminant transport are to be understood. Please prepare iso-concentration maps for each detected parameter above screening levels, for each sampling event. The maps should be contoured at sufficient detail to show the edge of the plume and concentration changes within the plume.

17) Page 4-29, Section 4.4.6 – The discussion of concentration trends over time argues that there is no consistent trend in RI or Yard 520 monitoring data due to seasonal variation in water chemistry and that there is no information to indicate concentrations downgradient of Yard 520 are likely to change significantly. This conclusion is predetermined by the sampling frequency and duration that was used in the RI. It is not possible to isolate seasonal variation from temporal trends and random variation when the sampling duration is a single seasonal cycle plus one sampling interval. Therefore, the inevitable result of a program with this sampling frequency and duration is to build, for all systems with seasonal variation and/or trending water quality, background statistics that over-estimate the range and variability of the system and correspondingly mask impacts. Construction of detailed iso-concentration maps (see comment #16) would assist in identifying transient (trend or seasonal) groundwater quality. Groundwater quality changes could be projected into the future if adequate transient groundwater modeling is performed. The observed increasing leachate head within Yard 520 documented during the RI documents a system that is not yet in a state of dynamic equilibrium. Increased head within Yard 520 will inevitably result in increased flow and contaminant concentrations in the plumes in the vicinity of Yard 520. This too, could be better evaluated with an adequate transient groundwater model.

18) Page 4-30, Section 4.4.6 – Review of the graphs imbedded in the text of this section shows that only a subset of the Yard 520 monitoring wells are included on the graph for each parameter evaluated. The wells shown on the graphs are different for each parameter. There is no discussion of how wells were selected for graphing. In spite of what appears to be careful selection of data to be shown, the boron graph on page 4-30 shows an interesting detail. The concentration of boron in wells MW-6, located on the northeastern edge of Yard 520 clearly shows increasing boron concentrations over the period of the record. This observation is consistent with increasing head in Yard 520 driving more flow away from the landfill toward the north.

19) Page 4-50, Section 4.6 - This section states, "… the chemistry of sediments is similar to that of the soil and geologic materials within the local watershed as sediments are derived primarily from these materials". We agree with this statement, although the authors of the RI appear to miss the full significance of the observation. Since soil samples collected by the PINES citizen's group in areas outside and upstream of the Area of Concern showed various amounts of CCB present in the surface soils upstream of Yard 520, it is not unexpected to find CCB-related metals in

"background" sediments. It is incorrect to assume that any samples upstream of Yard 520 are unimpacted by the widely distributed CCB's in the area.

20) Page 4-51, Section 4.6.1 – In referring to upstream sediment characteristics the respondents make the statement that, "Based on their positions, samples from these locations are not affected by CCB-derived constituents." In an area like Pines where CCB has been disposed in many locations, both identified and unidentified and some known to be upstream and upgradient of the Area of Investigation, it is inadequate and inappropriate to depend solely on location as the indicator that a sample is unaffected by CCB's. Refer to Attachment 2 for confirmation that CCB's are present in soil locations upstream of Yard 520.

21) Page 4-53, Section 4.6.1.2 - This section makes the statement, "Because of their locations, none of these constituents in upgradient sediments are related to CCB's." Soil samples collected by the PINES citizen's group in areas outside and upstream of the Area of Concern showed various amounts of CCB present in the surface soils, and it is not unexpected to find CCB-related metals in "background" sediments as defined in the RI.

22) Page 4-59, Section 4.6.2.2 – The discussion of total metals concentration, TOC and other supposed issues related to evaluating Brown Ditch sediment analyses appear to be an elaborate smokescreen designed to obfuscate the dramatic increase in CCB-related metals in Brown Ditch adjacent and downstream of Yard 520 and other CCB locations. The concentrations of several metals dramatically increase adjacent to known CCB disposal areas and then slowly decline downstream. The respondents make much of the fact that total metals is generally higher in clay and silt-sized sediment than in sandy sediments, and attribute that to the high aluminum content in some clays. A change in grain size however does not account for increases in CCB-related and other metals generally not associated with clays. Further, the discussion ignores the expectation that CCB-impacted groundwater discharging to the bottom of Brown Ditch encounters chemical and mineralogical conditions that cause the CCB-derived metals to precipitate from solution as, or adsorb onto, fine particles within the bottom sediments. This expectation accounts for the observed increase in fine-grained sediment, the dramatic increase in metals content adjacent to and downstream of Yard 520, and the gradual decline in concentrations further downstream. The observational data from Brown Ditch are singularly consistent with a baseflow containing CCB-derived metals.

23) Appendix L - The groundwater model is unusable for project purposes and none of the reported simulations reflect real-world conditions. The model could not be calibrated to reflect water level measurements without ignoring PZ001. As noted earlier, this was not mentioned in the draft RI Report text or in the text of Appendix L. It was only acknowledged as a note at the bottom of Table 2-2 in the Appendix. Unfortuanately, this creates the appearance of an attempt to hide the fatal limitation from EPA, IDEM and the public. A model that will not calibrate without censoring critical data is a non-functional, unreliable model. None of the simulations run on the dysfunctional groundwater model honor real-world head in PZ001 and Yard 520. Removing the data point that reflects the highest head anywhere in the domain in order to attain pseudo-calibration invalidates the model and casts doubt on all discussions and/or conclusions in the RI report.

24) Appendix L – The groundwater model eliminates the Yard 520 South Area from the groundwater flow system. This is neither appropriate nor accurate and is probably a source of some of the model calibration problems encountered. Any low permeability barriers around the Yard 520 South Area that were constructed will slow, but not eliminate groundwater flow. The lateral hydraulic gradient across clay barriers will be steep, but flow is not totally eliminated. The model should reflect the best estimation of groundwater flow conditions, and it is known that leachate from the South Area can migrate from it under an outward gradient. Removing an entire landfill on the basis of what may be wished were true is not the best available estimation. The model must be re-done to accurately reflect real-world conditions.

25) Appendix L - Since the caps on each of the landfill areas are equivalent, one would expect that a groundwater mound is also developing in the Yard 520 South Area. In fact, the South Area mound may be developing more rapidly than the mound observed in the North Area because flow out of the unit may be slowed by the presence of the low permeability barriers. The model must be re-done to accurately reflect the observed or expected real-world conditions. In this case, that may require more piezometers within the CCB disposal areas.

26) Appendix L – The rising heads over the period of record at PZ001 demonstrate that the Yard 520 Landfill complex has yet to reach the state of dynamic equilibrium that can be simulated with a steady-state model. This creates an unusual challenge for the modeler(s). Existing and historical hydrologic data, including historical concentration data, are inappropriate for calibration purposes of a steady state model, because those data were not collected under the steady-state condition; that condition has yet to be achieved. The appropriate modeling exercise for the Pines Area of Interest is to construct a model that is calibrated with known flux and boundary conditions to produce a simulated steady-state that will eventually be reached. Once that model is constructed, the historic site head and concentration data are properly used as verification conditions against which to test the transient model’s ability to match historic. Once that verification is accomplished, then the model can be used to predict the eventual impacts of Yard 520 and other CCB dumping grounds on the population and environment will be when dynamic equilibrium is finally reached.

Attachment 1

Larry Jensen Comments on the

"Evaluation of the Data Collected Under the

Yard 520 Sampling and Analysis Plan"

June 11, 2008

Review comments by
Larry Jensen on

Evaluation of Data Collected Under the Yard 520 Sampling and Analysis Plan

Pines Area of Investigation
AOC II
Docket No. V-W-'04-C-784

ENSR Corp
May 19, 2008
Document Number 01776-028-100a

Background Samples

- Generally, U.S. radiation backgrounds for the uranium-238 and thorium-232 natural decay series radionuclides are about 0.5 – 1.5 picocurie per gram (pCi/g). The radiation background for the uranium-235 natural decay series is about 0.046 pCi/g.

- Radium backgrounds were in the normal range, not exceeding 1 pCi/g.

- Uranium backgrounds were in the normal range with the exception of site SS018 which was 1.95 pCi/g for uranium-238 when measured by gamma spectrometry.

- Uranium measurements by inductively Coupled Plasma Mass Spectrometry (ICPMS) list total uranium as the sum of uranium-238 + uranium-235. This is incorrect. Total uranium is the sum of uranium-238 + uranium-234 + uranium-235. It is important to have the uranium-234 level if a conversion from mg/kg to pCi/g is necessary.

- Results for ICPMS do not contain any uncertainties, nor any detection limits. It is, thus, not possible to judge the quality of the results.

- U-238 backgrounds by Inductively Coupled Plasma Mass Spectrometry (ICPMS) did not exceed 1 mg/kg except for sites SS008, SS018, and SS021 which were 1, 6.1, and 1 mg/kg, respectively. It should be determined if these were local variations, problem locations, or if there was a malfunction in sample collection or in laboratory measurement. Most especially, SS018 should be investigated.

- U-235 backgrounds by ICPMS did not exceed 0.009 mg/kg except for sites SS018 and SS022 which were 0.044 and 0.013 mg/kg, respectively. Again, these anomalies should be investigated, especially SS018.

- The U-238 and U-235 background water concentrations were identical across three sites. Getting the exact concentration in each measurement is unexpected and puzzling. This might be a laboratory issue.

- The GEL Laboratories water sample results (Sample IDs 202261001 to 202261031) have such high uncertainties that they cannot be used.

  Also, the Detection Limits (DL) were set so high that they did not apply to reasonable comparison standards such as the USEPA 40 CFR 192 Total Radium (radium-226 + radium-228) soil standard of 5 picocuries per gram (pCi/g) plus background. This is most likely a problem of not counting the sample long enough. The DL could have been brought down below 5 pCi/g if the sample had been counted longer. As a result, the Total Radium standard could not be compared to the data to determine if there might be contamination.

- The Total Radium soil background concentration of 0.618 pCi/g is important. It will be discussed in later comments.

Yard 520 Samples

- The USEPA wrote a total radium standard for the cleanup of uranium and thorium soils, 40 CFR 192. It has been used consistently by USEPA Region 5 and is applicable to Yard 520 for judging the data. The standard is 5 pCi/g plus background for the sum of radium-226 and radium-228 or 5.618 pCi/g for the Pines area.

- Five of the 11 measured samples exceed 5.618 pCi/g (GP005, GP006 , GP007, GP009, and GP010). This is an indication of possible contamination.

- There is no comparable soil standard for uranium. It is reasonable to compare data to background concentrations.

  U-238 (by gamma spectrometry)
  range 2.20 - 4.77 pCi/g
  range 7 – 15 times the Pines average gamma spectrometry background

  U-234 (by gamma spectrometry)
  range 2.06 – 5.38 pCi/g
  range 7 – 19 times the Pines average gamma spectrometry background

  U-235 (by gamma spectrometry)
  range 0.0774 – 0.347 pCi/g
  range 1.5 – 7 times the Pines average gamma spectrometry background

  U-238 (by ICPMS)
  range 6.09 – 14.5 mg/kg
  range 10 – 23 times the Pines average ICPMS background

  U-235 (by ICPMS)
  range 0.0445 - 0.105 mg/kg
  range 8 – 19 times the Pines average ICPMS background

  Some of these sites deviate substantially from their surroundings. The cause(s) should be investigated.

- There are two standards for judging water samples. These are the Total Radium (Radium-226 + Radium-228) concentration and the Total Uranium (Uranium-238 + Uranium-234 + Uranium-235) concentration found in the USEPA Drinking Water standards (Title 40, Part 141, Code of

Federal Regulations, 40 CFR 141). These are 5 picocuries per liter (pCi/L) including background for Total Radium and 30 micrograms per liter (ug/L) including background for Total Uranium.

- For the one radium water measurement made at GP004 by gamma spectrometry, the Total Radium including background appears to be 20.58 pCi/L or 4 times the standard. However, the uncertainties are higher than the results and the detection limits are well above 5 pCi/L, the USEPA Total Radium standard. These radium in water data are not usable.

- For the one uranium water measurement made at GP004 by gamma spectrometry, the measurements were made in pCi/L. When converted to ug/L, the Total Uranium level appears to be 479 ug/L or 16 times the standard. Again, however, the uncertainties are higher than the results and the detection limits are well above 30 ug/kg, the USEPA Total Uranium standard. These uranium in water data are not usable.

- For the one uranium water measurement made at GP004 by ICPMS, the levels are

  U-238 4 times the Pines average ICPMS background

  U-234 7 times the Pines average ICPMS background

  U-235 1.4 times the Pines average ICPMS background

- The measurements for U-238 and U-235 by gamma spectrometry are not comparable to the measurements by ICPMS. The U-238 and U-235 concentrations by gamma spectrometry, 473.5 ug/L and 5.273 ug/L, respectively, are substantially different from the concentrations by ICPMS, 0.200 ug/L and 0.070 ug/L, respectively. This appears to be an issue with measurement uncertainties.

Sediment Samples

- When compared to the Total Radium standard (5.618 pCi/g), no sediment sample exceeds this standard.

- Uranium can be compared to background soil concentrations

  U-238 (by gamma spectrometry)
  range 0.135 – 0.863 pCi/g
  range 0.4 – 3 times the Pines average gamma spectrometry background

  U-234 (by gamma spectrometry)
  range 0.209 – 1.62 pCi/g
  range 0.8 – 6 times the Pines average gamma spectrometry background

  U-235 (by gamma spectrometry)
  range .0162 – 0.163 pCi/g
  range 0.3 – 3 times the Pines average gamma spectrometry background

  U-238 (ICPMS)
  range 0.160 – 0.890 mg/kg
  range 0.3 – 1.4 times the Pines average ICPMS background

U-235 (ICPMS)
range 0.0029 – 0.00657 mg/kg
range 0.5 – 1 times the Pines average ICPMS background

There appears to be somewhat elevated uranium in the sediments.

Conclusions

- Background soil sample SS018 should be checked to determine why it is anomalously high.
- Uranium measurements by inductively Coupled Plasma Mass Spectrometry list total uranium as the sum of uranium-238 + uranium-235. This is incorrect. Total uranium is the sum of uranium-238 + uranium-234 + uranium-235.
- The three background water samples measured by ICPMS for uranium (SS003, SS012, SS021) should be checked to determine why they were identical in every measurement.
- Five of the 11 Yard 520 soil samples exceed the 40 CFR 192 Total Radium standard. (GP005, GP006, GP007, GP009, GP010). Although the highest is 7.26 pCi/g (standard, 5.618 pCi/g), this nevertheless is indicative of contamination.
- Uranium concentrations in Yard 520 soil samples were measured to be as much as 23 times Pines' background concentration. The highest was for U-238 at GP008.
- The single water sample taken at GP004 showed uranium concentrations as high as 7 times the background concentration.
- It is unclear why measurements for U-238 and U-235 by gamma spectrometry are not comparable to the measurements by ICPMS.
- No sediment samples exceeded the 40 CFR 192 Total Radium standard.
- Uranium concentrations in sediments were measured to be as much as 6 times the Pines' background concentration. The highest was for U-234 at SW022.
- Some measurement uncertainties are so high as to make the results unusable.
- Some measurement detection limits are so high that the results cannot be compared to reasonable USEPA standards. This appears to be a problem of not counting the samples long enough.
- ICPMS results have no uncertainties and no detection limits. It is not possible, as a result, to judge the quality of these data.

Attachment 2
Soil Characterization Report
by Dr. Maria Mastalerz

Petrographic characterization of samples No.1-No. 5

Techniques: Reflected light microscopy (Zeiss Photoscope microscope) and oil immersion was used to qualitatively characterize the samples. Samples were mounted in epoxy and prepared using the standard preparation technique for the reflected light.

Results: All the samples contained anthropogenic organic matter, but the contribution of these particles to the total sample varied. Samples #1 and 3 contained abundant anthropogenic particles, and they included coal fragments (Fig.3D), isotropic and anisotropic char (Fig. 1A,B, Fig. 3C), coke (Fig. 1C), and inorganic components such as spinel (Fig. 1D, 3B) and glass (Fig. 3A).

Samples #2, #3, and #4 have less anthropogenic particles, with the dominant contribution from the Illinois Basin coal (Fig. 2B,C, 4A). Other types of anthropogenic particles include isotropic char (Fig. 3C, spinel (Fig. 3B, 4B), and glass (Fig. 3A).

Interpretation: The samples analyzed contain anthropogenic particles resulting from coal utilization. The content of these particles in the samples vary from about 1% percent in sample #4 to probably more than 20% in sample #3.

The type of anthropogenic particles suggests that they come mainly from coal combustion (e.g., glass cenospheres, spinel, isotropic char, all possible components of fly ash). Some particles have well developed anisotropic(coke-type) texture, and may come either from coke plants or coal-fired power plants.

Insert pdf Pictures of Samples

Attachment 3
Graphical Analysis of Background Soil Data

Insert graphical analysis of background